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Green Dentistry as an Ethical Imperative in Sustainable Oral Healthcare

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Environmental sustainability has emerged as an important ethical concern in modern healthcare systems, including dentistry. The healthcare sector contributes significantly to environmental degradation through energy consumption, waste generation, and the use of resource-intensive technologies. Although dentistry represents a smaller component of healthcare services, dental practices generate considerable environmental impact through the use of disposable materials, hazardous waste, and energy-intensive equipment.[1]

Carbon emissions, often described as the carbon footprint, represent the total amount of greenhouse gases released into the atmosphere as a result of human activities, including healthcare delivery. Healthcare systems worldwide are estimated to contribute approximately 4–5% of global greenhouse gas emissions, largely through energy consumption, transportation, procurement of medical products, and waste management. Dental services contribute to this footprint through energy-intensive equipment, manufacturing of dental materials, laboratory processes, and repeated patient travel for clinical appointments. Understanding and reducing the carbon footprint of dental practice is therefore an essential component of environmentally sustainable oral healthcare.[1,2]

As a result, the concept of green dentistry, also referred to as sustainable or eco-friendly dentistry, has gained increasing attention as a framework for reducing the environmental footprint of oral healthcare while maintaining high standards of patient safety and clinical effectiveness.[2] Green dentistry promotes environmentally responsible clinical practices aimed at reducing waste, conserving resources, and minimising the release of harmful substances into the environment.[3]

Integrating sustainability into dental practice reflects the broader ethical responsibility of healthcare professionals to safeguard public health and environmental well-being for present and future generations.

Environmental Impact of Dental Practice

Dental clinics rely heavily on single-use materials and technologically intensive procedures, both of which contribute to environmental waste and pollution. Disposable items such as gloves, masks, plastic barriers, suction tips, and sterilisation packaging are widely used to maintain infection control standards, yet many of these materials are non-biodegradable and contribute significantly to clinical waste streams.[4]

In addition to general waste, dentistry generates hazardous materials including mercury-containing dental amalgam, heavy metals, and chemical residues from radiographic processing.[5] If improperly managed, these materials may contaminate water systems and ecosystems. Furthermore, dental equipment such as sterilisation units, suction systems, and radiographic devices requires substantial energy and water resources. Collectively, these factors highlight the need for more sustainable approaches to dental practice that reduce environmental impact without compromising patient care.

Ethical Foundations of Green Dentistry

The ethical justification for sustainable dental practice can be understood through the four principles of biomedical ethics – non-maleficence, beneficence, justice, and autonomy.[6]

The principle of non-maleficence, which requires healthcare professionals to avoid causing harm, can extend beyond individual patients to encompass environmental harm that indirectly affects population health. Environmental pollution and improper waste management associated with healthcare activities may contribute to broader public health risk[s.7]

In this context, greenhouse gas emissions generated by healthcare activities may also be considered a form of indirect harm, as they contribute to climate change, which is increasingly recognised as a major global health threat. From an ethical perspective, reducing the carbon footprint of healthcare systems aligns with the principle of non-maleficence by limiting environmental harm that may ultimately affect population health.

Beneficence emphasises promoting well-being and acting in the best interests of patients and society. Sustainable dental practices, including preventive care and minimally invasive treatments, can improve oral health outcomes while simultaneously reducing the environmental burden associated with complex restorative procedures.[8]

The principle of justice highlights the importance of fairness in the distribution of health resources and environmental burdens. Environmental degradation often disproportionately affects vulnerable populations; therefore, sustainable healthcare practices contribute to environmental justice by reducing the ecological footprint of healthcare systems.[9]

Finally, autonomy supports transparent communication and informed decision-making in healthcare. Increasingly, patients are aware of environmental issues and may prefer healthcare providers who adopt environmentally responsible practices.

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Informing patients about preventive and sustainable treatment options can therefore support shared decision-making and strengthen trust in the dental profession.10
Principles and Practices of Green Dentistry

Green dentistry is often guided by the principles of rethink, reduce, reuse, and recycle, which encourage environmentally responsible clinical practice. Several strategies have been proposed to support the transition to sustainable dental care.[11] First, improved waste management practices, including waste segregation, recycling programs, and the safe disposal of hazardous materials such as amalgam waste, can significantly reduce environmental contamination. The use of amalgam separators has also been recommended to prevent mercury from entering wastewater systems.[12]

Second, the adoption of digital technologies may reduce environmental impact. Digital radiography eliminates the need for chemical processing associated with conventional film radiographs, while electronic patient records reduce paper consumption. Similarly, digital impressions and CAD/CAM technologies may decrease the material waste associated with traditional impression techniques.[13]

Third, energy and water conservation measures – such as energy-efficient equipment, LED lighting, and water-efficient dental units – can help reduce the environmental footprint of dental clinics. Finally, preventive and minimally invasive dentistry represents one of the most sustainable approaches to oral healthcare. Preventing oral disease reduces the need for resource-intensive treatments and therefore lowers the overall environmental impact of dental care.[15]

Challenges to Implementing Green Dentistry

Despite growing awareness of sustainability, the implementation of green dentistry remains limited in many settings. Studies indicate that while dental professionals often express positive attitudes toward environmentally responsible practice, sustainable strategies are not consistently integrated into routine clinical workflows.13,15
Several barriers have been identified, including financial constraints, limited awareness of sustainable practices, and the difficulty of modifying existing clinical protocols. Additionally, strict infection control requirements – particularly the widespread use of disposable materials – may present challenges when attempting to reduce waste while maintaining patient safety.

Role of Education and Policy

Education and policy development are essential for promoting sustainable dental practice. Integrating sustainability principles into dental curricula can increase awareness among future dental professionals regarding the environmental impact of healthcare practices and encourage environmentally responsible behaviour.

At the international level, the World Health Organisation has emphasised sustainability within oral healthcare through the Global Oral Health Action Plan 2023–2030, which encourages countries to adopt environmentally responsible oral health systems, improve waste management practices, and promote the use of mercury-free restorative materials. These initiatives align with the objectives of the Minamata Convention on Mercury, which calls for the gradual phase-down of dental amalgam and the adoption of safer alternatives.[14]

At the national level, regulatory bodies and professional organisations also play a crucial role. In South Africa, institutions such as the Health Professions Council of South Africa and the South African Department of Health contribute to the development of professional standards and healthcare policies that promote responsible waste management and ethical healthcare practice.[15]

CONCLUSION

Green dentistry represents an important ethical and professional responsibility within contemporary oral healthcare. As awareness of environmental challenges continues to grow, dental professionals must consider the ecological implications of their clinical practices. Applying ethical principles such as non-maleficence, beneficence, justice, and autonomy supports the integration of sustainability into dental care.

Through strategies including waste reduction, digital technologies, energy conservation, and preventive approaches, dentistry can reduce its environmental footprint while maintaining high standards of patient care. Continued research, education, and supportive policy frameworks will be essential to ensure that sustainability becomes a fundamental component of ethical dental practice.

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